UNITED STATES DEPARTMENT OF AGRICULTURE

SYLLABUS 35

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A. C. TRUE, Director
In Cooperation with the Bureau of Plant Industry
WM. A. TAYLOR, Chief

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ILLUSTRATED LECTURE ON SOY BEANS

By

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In cooperation with the Bureau of Plant Industry, Wm. A. Taylor, Chief.

SYLLABUS 35—ILLUSTRATED LECTURE ON SOY BEANS.[1]

By W. J. Morse, *Scientific Assistant, Forage-Crop Investigations, Bureau of Plant Industry,* and H. B. Hendrick, *Specialist in Agricultural Education, States Relations Service.*

INTRODUCTION.

View.

The soy bean is a native of southeastern Asia and has been cultivated in China, Korea, and Japan since ancient times. In these countries the soy bean has not only been utilized to a very considerable extent for human food, the beans being prepared in various ways, but also large quantities have been used by first extracting the oil and then using the cake for stock feed and as a fertilizer. At the present time the soy bean is the most important legume grown in Asiatic countries, both in the extent of uses and in its value, and its products have now become of special importance in the world's commerce. 1

The soy bean has been grown only to a limited extent in European countries, Germany, Russia, France, and Italy having shown the most interest in its production up to the present time. Since 1908 nearly all European countries have imported considerable quantities of soy beans, soy-bean cake and oil to a lesser extent. Dairy countries such as Holland and Denmark now recognize the value of bean meal for milk production and this feed now comes into sharp competition with cottonseed and linseed meal for the dairy ration. 2

It is only within recent years that the soy bean has become an important crop in the United States. It is now quite extensively grown for forage in Tennessee, North Carolina, Vir- 3

[1] This syllabus has been prepared by direct cooperation between the Office of Forage-Crop Investigations of the Bureau of Plant Industry, as regards subject matter, and J. M. Stedman, Farmers' Institute Specialist of the States Relations Service, as regards pedagogical form. It is designed to aid farmers' institute and other extension lecturers in presenting this subject before popular audiences. The syllabus is illustrated with 50 lantern slides. The numbers in the margins of the pages refer to the lantern slides as listed in the Appendix.

View.

ginia, Maryland, Kentucky, the southern parts of Illinois and Indiana, and is being introduced into still other States not only for forage but for seed purposes. In a few sections, such as eastern North Carolina, a very profitable industry has de-
4 veloped from the growing of seed. The large yield of seed, the ease of growing and harvesting the crop, the value of the beans for both human and animal food, and the value of the oil all tend to make this crop one of increasing importance and to assure its greater agricultural development in America.

FEEDING VALUE OF SOY BEANS.

The feeding value of any forage crop and for any particular purpose can be determined only by actual feeding experiments. There are, of course, definite relations between the digestible
5 constituents of a feed and the resultant gains in flesh or milk. These relations are, however, more complex than the table of analyses indicates. On this account the relative value of feeds is best shown by comparative feeding trials. Such trials indicate that good soy-bean hay is about equal to alfalfa for milk and butter production. They also show that soy-bean meal is somewhat superior to cottonseed meal in the production of
6 pork, mutton, and milk. Soy-bean meal also proves to be slightly more valuable than wheat middlings in feeding hogs.

FEEDING VALUE FOR SHEEP.

The Wisconsin Agricultural Experiment Station[1] has tested the value of soy-bean seed for fattening lambs. In one experiment two lots of 10 lambs each were fed the same roughage. One lot received shelled corn and whole soy beans in equal proportions, while the other received the same quantities of shelled corn and whole oats. The average gain of each lamb during a period of 12 weeks was 16.3 pounds when soy bean constituted a part of the ration and but 13.7 pounds when oats were used.
7 A pound of gain was produced on 6.11 pounds of grain and 7.11 pounds of roughage in the soy-bean ration, while 7.28 pounds of grain and 8.62 pounds of roughage were required on the oat ration.

In another experiment the same rations were fed for 12 weeks to two lots of 9 lambs each. The lot receiving the soy-bean ration gained 119 pounds in weight and produced 95.1 pounds of wool as compared with 71 pounds gain in weight and 81 pounds of wool produced by the lot receiving the oat ration. The second lot also consumed more feed per pound of gain.

[1] Wisconsin Sta. Rpts. 1904 and 1905.

FEEDING VALUE FOR DAIRY COWS.

Soy-bean meal has been found a most excellent feed for dairy cows. The Massachusetts Agricultural Experiment Station[1] compared soy-bean meal and cottonseed meal, using the same ration otherwise. The quantity of milk produced from the soy-bean ration was slightly larger. The butter from the cows fed cottonseed meal was of firmer texture but not nearly as good otherwise as the butter from the cows fed soy-bean meal. The test indicated that soy-bean meal was superior to cottonseed meal for both milk and butter production.

At the Tennessee Agricultural Experiment Station[2] three groups of cows of two lots each were fed to compare—first, soy-bean straw and corn stover; second, soy-bean hay and alfalfa hay; and third, soy-bean meal and cottonseed meal. There was no chance in these experiments for the individuality of the animals to affect the results, as each lot was fed on the separate rations at different periods in the course of the experiments.

8

Soy-bean straw was found very palatable and superior to corn stover as a feed. More feed was eaten in the case of the soy-bean straw, but the cost of the feeds consumed during the 30-day period was practically the same. The soy-bean ration produced 12 per cent more milk and 14 per cent more butter fat, so that the cost of a gallon of milk was 1.2 cents less, and of a pound of butter fat 2.10 cents less than when corn stover was fed as roughage.

In the comparison of soy-bean hay and alfalfa hay these substances were fed in combination with corn silage and corn-cob meal, each lot of cows consisted of four Jerseys and the test lasted through three periods of 30 days each. At the end of this time results were in favor of the soy-bean hay by 245 pounds of milk and 20.05 pounds of butter fat. This result indicates a slight superiority of soy-bean hay over alfalfa hay.

In the trial for the comparison of the soy-bean meal and cottonseed meal, the yield both of milk and of butter fat was about 5 per cent greater for the soy-bean meal.

FEEDING VALUE FOR HOGS.

The Wisconsin Agricultural Experiment Station[3] compared soy-bean meal and wheat middlings for pork production in three separate experiments in as many years. Two-thirds of the grain ration was corn meal in each case. In each of the

[1] Massachusetts Sta. Rpt. 1893, pp. 13, 14.
[2] Tennessee Sta. Bul. 80 (1908).
[3] Wisconsin Sta. Rpts. 1904, 1905, and 1906.

View.

experiments the largest gains were made on soy-bean rations. Soy beans proved to be about 10 per cent superior to wheat middlings for pork production, figuring the cost of the feeds as the same.

The Indiana Agricultural Experiment Station[1] compared rations of two parts of corn meal and one part of soy-bean meal with corn meal and wheat middlings in equal proportions, and with five parts of corn meal and one part of tankage for pork production. The soy-bean ration produced the largest daily gains and this with the smallest quantity of feed
9 consumed for each pound of gain.

The Kansas Agricultural Experiment Station[2] has several times tested the value of soy-bean meal in combination with corn meal and with corn meal and with kafir meal in comparison with the two latter feeds alone in feeding hogs. The feeds are mixed in the proportion of four-fifths corn or kafir and one-fifth soy beans. Larger gains, varying from 13 to 37 per cent, were made in every case on the mixed rations than on corn or kafir alone.

SOY-BEAN PASTURE.

The soy bean may often be utilized to advantage for pasture for all kinds of stock, the most profitable method, perhaps, being to pasture with hogs, supplementing the corn ration.
10 Soy beans and corn may be grown together or the soy beans may be sown broadcast at the last cultivation of the corn. By planting the same variety at different dates or by using varieties with different dates of maturity, the grazing may be extended over a considerable period. As a pasture crop the soy bean is not only profitable for the feed produced, but also because of the increase of soil fertility due to the manure and refuse vines.

SOY-BEAN SILAGE.

When grown for silage, the soy bean is generally combined with corn, as soy beans alone do not make a good quality of silage. Good results are secured where soy beans and corn are mixed, two or three parts of corn and one part of soy beans.
11 This silage keeps well, is readily eaten by stock, and the animals show good gains in flesh and milk production.

SOY-BEAN HAY.

Soy beans when cut at the proper stage of growth and carefully cured make a very nutritious hay, which is relished by

[1] Indiana Sta. Bul. 108 (1905).
[2] Kansas Sta. Bul. 92 (1900), pp. 24, 25; Press Bul. 141 (1905).

all kinds of live stock. The chief value of soy-bean hay lies in its high content of digestible protein. As compared with the hay of other leguminous crops, soy-bean hay is equal, or superior, to any in feeding value. The use of soy-bean hay, which can be grown on the farm, should be the means of materially reducing so much purchased feed. The ordinary yields of soy-bean hay on different soils range from 1 to 3 tons to the acre, and occasionally 4 tons are cut.

VALUE OF SOY BEANS OTHER THAN FOR STOCK FEED.

SOY BEANS FOR SEED.

The character of growth of the soy bean, its uniform maturing habit, and its large yield of grain all recommend it for seed production. The Cotton Belt and the southern part of the Corn Belt, however, are most favorably situated for the production of seed. The yields of seed to the acre in various sections of the United States range from about 15 bushels in the Northern States to about 40 bushels in the northern half of 12
the Cotton Belt. The seed-growing industry has thus far been developed mainly in a few sections, such as eastern North Carolina, where the average yield is about 25 bushels, although many fields produce 35 bushels or more to the acre. Growing soy beans for the grain for use as feed is distinctly profitable even with a yield of 16 bushels per acre.

SOY BEANS FOR OIL.

The use of cottonseed meal for feeding beef cattle and dairy cattle has increased to large proportions within recent years. A shortage of cottonseed in the South and a surplus of soy-bean seed in North Carolina in the later part of 1915 led several cotton-oil mills of the State to enter extensively upon the production of soy-bean oil and meal. Many cotton-oil mills in the South, especially in the boll-weevil sections, are now 13
developing this new industry. The yield of oil varies to a great degree with the variety, ranging from 13 to 24 per cent. On an average, 1 ton of beans will yield by the expeller process 30 gallons of oil and 1,600 pounds of meal, the loss representing moisture from evaporation and impurities. With seed at $1 a bushel and with normal prices for the oil and soy-bean cake, the mills find it profitable for them to extract the oil.

This oil has a good color, has but a faint odor, and is rather palatable. In many respects it resembles cottonseed oil but is of a more pronounced drying character. With the rapid growth of the soy-bean industry many new trade uses for the

Vlew.

oil have been found and on account of its lower cost it has become an important competitor with other vegetable oils.

Soy-bean oil has been studied with other oils in a series of experiments carried on by the Office of Home Economics and found to compare favorably with the more common culinary table oils with respect to the thoroughness with which it is assimilated.

SOY-BEAN MEAL AS A FERTILIZER.

For centuries soy-bean meal has been used for fertilizing purposes in Asiatic countries, but not until the recent production of bean cake and oil in the Southern States from southern-grown beans have fertilizing manufacturers become interested in the possibilities of the meal and purchased considerable quantities for use as fertilizer.

Like cottonseed meal, soy-bean meal contains considerable amounts of phosphoric acid and potash, a large proportion of
14 which is "available," but it is principally valued in fertilizing as a source of nitrogen. If the price is determined on the same basis as that used in calculating the fertilizing value of cottonseed meal, the soy-bean meal is a more valuable product.

Although soy-bean meal has a high value as a fertilizing material, the more economical practice would be to feed the meal to stock and apply the resulting manure to the soil. Feeding experiments indicate that much of the fertilizing value of feeds is recovered in the manure.

SOY BEANS AND SOY-BEAN MEAL AS HUMAN FOOD.

As a human food soy-bean flour has been used principally in the United States as a special article of diet and is sold by a
15 number of food companies manufacturing special foods. Extensive tests are being conducted by the United States Department of Agriculture with soy-bean flour in the making of bread.[1] The flour or meal can be successfully used as constituent for muffins, bread, and biscuits in much the same way as corn meal. In these various food products about one-fourth soy-bean flour and three-fourths wheat flour have been found to be the proper proportions. When a special food of low starch content is desired, as for diabetic persons, a larger proportion of soy flour is used and some form of gluten is sub-
16 stituted for the wheat flour. The addition of the soy flour
17 changes the proportion of protein and carbohydrates in the mixture.

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[1] See U. S. Dept. Agr., Farmers' Buls. 58 (1899) and 121 (1909) and Office Expt. Stas. Bul. 159 (1905).

The soy bean can also be prepared directly as human food in numerous ways. The green bean when from three-fourths to full grown can be prepared like green peas, or green Lima 18
beans and compares favorably with these in palatability. In this stage of growth the beans can be canned like other green vegetables and should appeal to canning clubs on the lookout for new and valuable foods. The soy bean thus preserved furnishes a cheap, nutritious food of commercial importance. The dried beans also may be used in the same way as the field or navy bean in baking or in soups. Soy beans are now being sold on the market in the form of baked pork and beans. Several large canners are now putting up this product and the industry seems to be established on a permanent basis. In addition to other uses given, the soy bean has been utilized not only in the United States but in European countries as a substitute for the coffee bean. When roasted and prepared it makes an excellent substitute for coffee. In Asia the dried beans, especially the green-seeded varieties, are soaked in salt water and then roasted. This product is eaten after the manner of roasted peanuts.

REQUIREMENTS FOR SUCCESSFUL PRODUCTION.

SOIL AND CLIMATE.

The soy bean has a wide adaptation as regards soil and climatic conditions. In general, the northern limit of its adaptation in the United States may be said to be that of corn, and the southern limit that of cotton. In other words, it will 19
succeed in the United States wherever corn or cotton are cultivated. It is especially adapted to the Cotton Belt, where the later and larger varieties which give yields that make their extensive cultivation profitable can be grown.

The soil requirements of soy beans are quite similar to those of corn, but the plants will make a satisfactory growth on poorer soil than corn, especially if inoculated. The best 20
results, perhaps, are obtained on medium loams, although clay and sandy soils may be made to produce good crops. The soy bean does not require a well-drained soil, although a soil where water stands for a considerable length of time is not desirable. It is able to withstand a greater amount of moisture, however, than either cowpeas or corn. The soy bean is also decidedly drought resistant; much more so than the cowpea.

Rabbits are exceedingly fond of the soy bean and often cause 21
considerable damage. For this reason it is well to avoid planting the soy bean near woods.

View.

SOIL PREPARATION.

Soy beans succeed best on a thoroughly prepared soil. The land should be plowed early and deep, fitted, and then harrowed at intervals until the beans are planted. The young plants of soy beans are not able to push their way through a hard crust as are corn and cowpeas; thus to insure a good stand, the seed should have a light covering of loose, mellow soil.

FERTILIZERS.

The use of commercial fertilizers is recommended where sandy soil predominates or the soil is of low fertility. The best results with fertilizers are to be secured by using a dressing of stable manure or 300 pounds of acid phosphate, 250 pounds of wood ashes, or 25 to 50 pounds of muriate of potash. When neither wood ashes nor muriate is to be obtained, acid phosphate alone can be used to good advantage. In using commercial fertilizer it is well to apply it broadcast before the
22 beans are planted. Lime has been found almost invariably to increase the yield.

INOCULATION.

Soy beans like other legumes when well inocuated add much nitrogen to the soil. Natural inoculation now occurs quite generally throughout the soy-bean region in the southern United States. In localities where the crop has not been
23 previously grown, however, it is advisable to inoculate. Inoculation may be secured through the use of pure culture or by the use of soil from a field where the plants have previously developed nodules. The inoculated soil may be either drilled in at the time of seeding, using the fertilizer box and about 300 pounds of soil to the acre, or by mixing about a gallon of the soil thoroughly in a bushel of seed.

Where soil for inoculation can not be readily secured, a liquid culture containing the right kind of bacteria is often successfully used. A limited supply of this culture may be secured,
24 free, upon application to the United States Department of Agriculture. Some State experiment stations also furnish the liquid culture to farmers residing within the State, and there are also commercial firms which manufacture and sell this material. Directions for the use of the liquid culture always accompany it.

SEEDING AND CULTIVATION.

Soy beans may be sown at any time after danger of severe frosts is over, ranging from early spring until midsummer.

As a general rule, they may be planted about the regular time for planting corn in any particular locality. In the cotton region two crops of the early and medium-early varieties can be grown in a single season by planting the first early. However, for the best results the late varieties are usually preferable in the South.

Soy beans are grown either in cultivated rows or broadcasted, depending on the purpose for which they are grown. The row method is preferable in weedy land and usually gives larger yields of hay, and practically always of seed. The general practice for seed production is the row method, 30 to 40 inches apart. For hay, soiling, or green manure a drilled or broadcasted crop furnishes a finer quality of forage. In rows from 20 to 30 pounds of seed to the acre are required; when broadcasted or drilled, from 60 to 90 pounds.

Soy beans are generally drilled with an ordinary grain drill. By covering the seed cups not in use, the distance between rows can be adjusted as desired. The corn planter and also the cotton planter will also be found satisfactory for use in planting large fields. For small fields the ordinary garden drill does well.

Under proper soil conditions soy beans germinate in three to five days. As soon as the seedling plants appear above the ground cultivation may begin. In case beating rain occurs after sowing the beans, forming a crust upon the surface of the ground before the plants are up, the crust should be broken by the use of a weeder or light harrow. This light cultivation will not injure the seedlings, but will enable the plants to come up without injury. Soy beans should receive at least three cultivations during the season.

VARIETIES.

Variety is a matter of prime importance with the soy bean. It is largely determined by the color and size of seeds, though they differ in maturity, habit of growth, etc. Soy-bean seed should be selected with the idea of getting a variety suitable to the locality where it is to be grown, not growing the early varieties in the South nor the late ones in the North. Following are brief notes on the more important varieties:

Mammoth (seeds, straw yellow).—This is the standard commercial late variety, more extensively grown at the present time than any other. The Mammoth yields well and is satisfactory for both grain and forage. It can not be expected to mature north of Tennessee and Virginia.

Guelph (seeds, green).—This variety is also known as Medium Green, Medium Early Green, and Large Medium Green. It is about two

View.

weeks later than the Ito San. The Guelph is grown to a considerable extent in the Northern States. It is esteemed for its forage, and although it gives a good yield of grain it shatters badly before all of the seed is mature.

Haberlandt (seeds, straw yellow).—This variety is about a week later than the Guelph. The Haberlandt is one of the most satisfactory varieties for grain production, but is not especially desirable for hay.

Tokio (seeds, olive yellow).—This variety is about a week earlier than the Mammoth. The Tokio has rather a stocky growth for forage, but gives a heavy grain production.

31 Ito San (seeds, straw yellow).—This variety is also called Yellow. Dwarf Yellow, Early Yellow, Medium Yellow, and Early White. It will mature in about 100 days and can be grown well in the Northern States. The Ito San is very satisfactory for forage and also produces a good yield of grain.

Medium Yellow (seeds, straw yellow).—This variety, sometimes sold as Ito San and Hollybrook, appears identical with the Mongol and the Roosevelt. It matures about the same time as the Guelph and is satisfactory both for hay and seed production.

Manchu (seeds, straw yellow).—An early variety obtained from northern Manchuria, maturing about with the Ito San. The Manchu gives an excellent production of forage and seed, excelling the Ito San in both respects. Excellent results have been obtained with this variety in the Northern States.

Wilson (seeds, black).—This variety matures about the same time as
32 the Haberlandt. It gives a good grain yield, but is most satisfactory for hay.

Peking (seeds, black).—This variety has small, flat seeds and matures in about 120 days. The Peking not only gives a good yield of grain, but is most excellent for hay.

Black Eyebrow (seeds, black and yellow).—An early variety obtained from Manchuria, maturing about the same as the Manchu. The Black Eyebrow is very satisfactory for both hay and seed production. It is most suitable as a grain variety for the Northern States.

Biloxi (seeds, brown).—A variety characterized by its dense bushiness and coarse, erect stems. As this variety requires a very long season in which to make its full development, it is adapted only
33 to the southern part of the Cotton Belt. It is especially suited to the rice lands, being valuable for forage, ensilage, and green manure.

Barchet (seeds, brown).—This variety requires a rather long season, maturing about 10 days later than the Mammoth. The Barchet makes a good growth, has fine stems, and is especially desirable for hay and green manure in the Gulf States.

PLACE IN THE CROPPING SYSTEM.

Soy beans may be combined advantageously in many systems of cropping rotations. The cash value of the seed is sufficient to warrant the growing of these beans in many sections as one of the main crops of the rotation. In the

South, soy beans may be used in practically the same place in the rotation as cowpeas. Farther north they are being substituted to some extent for oats or wheat in the rotation. In some southern localities the soy-bean crop is grown between two wheat crops, and in other sections between two oat crops. Where a whole season is devoted to soy beans two crops of the earlier varieties can be matured in all parts of the Cotton Belt. and this is in some cases preferable to growing a single crop of a late variety. Where the whole season is devoted to soy beans they may take any place in a rotation system where corn can be used. Winter grains will usually do better following a crop of soy beans than after a crop of corn.

MIXTURES.

Soy beans may be grown satisfactorily in combination with other crops, thus affording a greater variety and larger yield of forage. A mixture of soy beans and cowpeas makes a very satisfactory hay. Soy beans may also be grown either for hay or for ensilage in a mixture with sorghum. Sudan grass 34
is also excellent for growing with soy beans, both the yield and the quality of the forage being improved by the mixture. Soy beans are more generally grown with corn, however, than 35
with any other crop. This mixture is planted in different sections in various ways; namely, in alternate hills with the 36
corn in the same row, in alternate rows of each, in alternate series of two rows of each, or broadcasted in mixture. Such 37
fields when planted in rows may be harvested for silage, or where the rows alternate the two crops may be harvested separately. Mixed fields may also be profitably utilized by pasturing to hogs. Early and medium varieties of soy beans are sometimes planted in between the corn rows at the time of the last cultivation. Silage made from a crop of corn and soy beans in combination is an excellent succulent feed. The larger late-growing varieties are most desirable for this purpose.

SPECIAL ROTATION.

In the southern part of the North-Central States and in some other sections of similar latitudes where general farming is practiced a rotation which has come to be used considerably is corn, soy beans, wheat, and hay, in the order named. The soy beans 38
in this rotation may be harvested either for hay or as a grain crop. Where the hay crop contains a large percentage of clover this rotation will be seen to contain two leguminous crops in each four or five years of the rotation.

View.

A modification of the above rotation which has become very popular in sections where many hogs are raised is corn and soy beans in mixture, corn, rye, and clover. In this case, the field of corn and soy beans is hogged down; the field of corn is harvested and fed in winter, the rye is pastured during fall and early spring and afterward permitted to ripen for grain, while the clover field is also pastured by the hogs to a considerable extent. This rotation under favorable conditions results in large profits with a minimum of labor, while the fertility of the soil under this system will be maintained or even built up.

The soy bean can be used to advantage for green manure, greatly increasing the supply of humus and nitrogen in the soil. The crop may be grown after wheat or a fall-sown crop. In many localities soy-bean seed is sown at the last cultivation of corn either for turning under or hogging down. Soy beans are ready for plowing down at the blooming stage, as most of the nitrogen has been gathered by this time.

HARVESTING AND STORING.

The beans may be cut for hay at any time from the setting of seed until the leaves begin to turn yellow. The crop is best
39 fitted for hay when the pods are well formed. Soy-bean hay is cured much more readily and is more easily handled than cowpea hay.

The planting of soy beans for hay should be timed, if possible, so that the crop can be cut in September, as this month is usually most satisfactory for haymaking. The cutting may begin as soon as the dew is off the plants and continue for the rest of the day. The plants should be allowed to lie in swath until the leaves are well wilted, but great care should be exercised to rake them before the leaves become dry and brittle. After raking into windrows they should be left for a day or two, depending on the weather, and then put in small cocks or bunches. Three to five or six days of good weather is ample time for making good soy-bean hay. Great care should be
40 used to prevent the loss of leaves, since these are the most valuable part of the plant except the pods.

When the hay is dry it should be put in good-sized stacks or under a shed. If it is stacked in the open field it is very essential that some other material, either grass or a canvas cover, be put over the stack, as soy-bean hay does not shed rain well.
41 Curing frames can often be used to good advantage in making soy-bean hay, especially in unfavorable weather. The object of these frames is to keep the cocks open, allowing the free cir-

culation of air in them and thus preventing molding. They are usually three or four sided pyramids made of boards or poles 3 to 6 feet long fastened together at the top and held by crosspieces near the base. By this device a hollow cock or shock is secured.

CUTTING SOY BEANS FOR SEED.

When grown for grain alone soy beans may be cut at any time after the yellowing of the upper leaves until all of the leaves have fallen. The plant should remain in the field until the seed is thoroughly cured. In harvesting the crop for seed a self-rake reaper or mower with side-delivery attachment or a binder will do very satisfactory work. If only a small area is grown soy beans may be cut with a sickle or pulled, tied in bundles, and flailed out when thoroughly dry.

Soy beans may be thrashed with an ordinary grain thrashing outfit with a few simple adjustments. The cylinder should be run at one-half the speed used in thrashing grain, but at the same time the usual rate should be maintained for the rest of the separator. Special bean and pea separators and bean harvesters are now on the market and do very satisfactory work. Soy beans may be thrashed in the field without previous stacking, or they may be stacked or housed and thrashed later. For the best results soy beans should be thoroughly dry for thrashing; otherwise much of the seed will remain unthrashed.

STORING.

After the soy beans are thrashed they should be placed in shallow bins or spread out on a floor for a time. The massing of large quantities of beans, especially if they are not thoroughly dry, will cause them to heat and thus will prevent germination. Under whatever conditions stored, the seed should be examined carefully to detect any tendency to heat. The seed of the soy bean, unlike that of the cowpea, is rarely attacked by the weevil or other grain insects. Soy beans do not retain their germinative power as well as cowpeas. Germination tests indicate that it is not advisable to sow seed two years old without previous testing.

SOY BEANS AND COWPEAS COMPARED.

Inasmuch as the soy bean is adapted to nearly the same place in the farm rotation as the cowpea, a comparison of the two plants will be helpful. (1) The value of the hay from the two plants is nearly the same. The grain from soy beans has somewhat greater feeding value than cowpeas. (2) Soy beans reach a definite size and mature. The pods all ripen at

View.

one time. Nearly all varieties of cowpeas, on the other hand, continue growing until killed by frost and the vines continue to produce green pods as long as the plant lives. (3) For growing with corn or sorghum as hay or silage or for green manuring and soil improvement the cowpea is preferable to the soy bean. (4) The soy bean will withstand greater extremes of drought, moisture, and cold than cowpeas. (5) The soy bean grows erect or nearly so and is in every way preferable to cowpeas for grain production.

50 The uses to which soy beans and soy-bean products are put are many, and the extent of their practical and profitable production is fast increasing.[1]

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[1] In addition to those mentioned elsewhere in this Syllabus, the following publications of the Department of Agriculture on the soy bean may be consulted:

Soy Beans. Farmers' Bulletin 372. 1909.

The Soy Bean; History, Varieties, and Field Studies. Bureau of Plant Industry Bulletin 197. 1910.

Soy Beans in the Cotton Belt. Unnumbered Circular of the Office of the Secretary. 1915.

The Soy Bean, with Special Reference to Its Utilization for Oil, Cake, and Other Products. U. S. Dept. of Agr. Bulletin 439. 1916.

Harvesting Soy-Bean Seed. Farmers' Bulletin 886. 1917.

Soy Beans in Systems of Farming in the Cotton Belt. Farmers' Bulletin 931. 1918.

The Soy Bean: Its Culture and Uses. Farmers' Bulletin 973. 1918.

The Soy-Bean Industry in the United States. In the Yearbook for 1917, pp. 101–111 and 6 pls. (Separate No. 740.) 1918.

APPENDIX.

LANTERN SLIDES.

No. of view.

1. A fleet of junks engaged in carrying soy beans to Newchwang from different points of the interior of China. At the same time they take away bean oil and bean cake to different places.
2. Coolies engaged in carrying their loads of soy beans up to big stacks, where they are kept until the factory needs them for oil manufacture.
3. A good field of soy beans. South Dakota.
4. A single selected soy-bean plant showing an abundance of pods.
5. Chart showing the composition of soy bean and other principal hays.
6. Chart showing analyses of soy-bean meal, cottonseed meal, and peanuts.
7. Comparative feeding value of soy beans for fattening lambs. Wisconsin.
8. Comparative feeding value of soy-bean meal for dairy cows.
9. Comparative feeding value of soy-bean meal for fattening hogs.
10. Soy beans used for hog pastures. North Carolina.
11. A good growth of corn and soy beans for ensilage.
12. A field of soy beans grown for seed.
13. Cotton-oil mill extracting soy-bean oil.
14. Fertilizing value of soy beans and cottonseed compared.
15. Comparison of soy-bean flour or meal with other flours.
16. Bread made from mixed wheat and soy-bean flour.
17. Muffins made from mixed wheat and soy-bean flour.
18. Photograph of cooked green soy beans used same as Lima beans.
19. Map of the United States showing localities best adapted for seed production.
20. Field of young soy beans showing the effect of poor drainage, in the center of the picture.
21. Field of soy beans showing damage by rabbits.
22. Liming for the correction of soil acidity as a result of the suggestions of the farm bureau and the county agent.
23. Comparison of inoculated and uninoculated soy beans on soil where the crop had not been grown before.
24. A soy-bean plant thoroughly inoculated, showing roots well covered with nodules.
25. View showing the appearance of soy beans when grown in rows.
26. Grain drill for planting soy beans.
27. Cultivating young soy beans.
28. Cultivating four rows of soy beans at once. This is a labor-saving machine.
29. The last cultivation of soy beans.
30. Two seeds each of Guelph, Tokio, Haberlandt, and Mammoth varieties of soy beans, showing color of seed and hilum and shape of seed.
31. Two seeds each of Ito San, Medium Yellow, Manchu, and Micado varieties of soy beans, showing color of seed and hilum and shape of seed.

No. of view.

32. Two seeds each of Wilson, Peking, Tarheel, and Black Eyebrow varieties of soy beans, showing color of seed and hilum and shape of seed.
33. Two seeds each of Biloxi, Early Brown, Virginia, and Barchet varieties of soy beans, showing color of seed and hilum and shaps of seed.
34. A mixture of soy beans and sorghum.
35. Soy beans planted in the rows with corn.
36. Soy beans planted with corn in alternate rows.
37. Soy beans sown broadcast in corn at the last cultivation.
38. An improved rotation for general or live-stock farming.
39. Soy beans in good condition for hay.
40. Loading soy beans with a hay loader.
41. A good form of rack for curing soy beans.
42. Proper stage for cutting soy beans for seed.
43. Cutting soy beans with a side-delivery reaper.
44. Pulled soy beans in the shock.
45. Soy-bean and cowpea thrasher.
46. Special soy-bean harvester.
47. Another type of soy-bean harvester in use.
48. Thrashing soy beans and baling the straw.
49. Soy beans on the right, cowpeas on the left.
50. Diagram showing the different uses of the soy bean and soy-bean product.

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